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| APPLICATION NO. | FILING DATE | FIRST NAMED INVENTOR | ATTORNEY DOCKET NO. | CONFIRMATION NO. |
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| 10/718,192 | 11/20/2003 | Yian-Liang Kuo | TS03-336 | 9795 |
| 7590 | 09/22/2004 | | EXAMINER | |
| STEPHEN B. ACKERMAN 28 DAVIS AVENUE POUGHKEEPSIE, NY 12603 | | | CHU, CHRIS C | |
| | | | ART UNIT | PAPER NUMBER |
| | | | 2815 | |

DATE MAILED: 09/22/2004

Please find below and/or attached an Office communication concerning this application or proceeding.

| Office Action Summary | Application No. | Applicant(s) |
|------------------------------|------------------------|---------------------|
| | 10/718,192 | KUO ET AL. |
| Examiner | Art Unit | |
| | Chris C. Chu | 2815 |

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

1) Responsive to communication(s) filed on 16 August 2004.

2a) This action is **FINAL**. 2b) This action is non-final.

3) Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

4) Claim(s) 25 - 56 is/are pending in the application.
4a) Of the above claim(s) 38 - 40 and 54 - 56 is/are withdrawn from consideration.

5) Claim(s) _____ is/are allowed.

6) Claim(s) 25 - 37 and 41 - 53 is/are rejected.

7) Claim(s) _____ is/are objected to.

8) Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

9) The specification is objected to by the Examiner.

10) The drawing(s) filed on 20 November 2003 is/are: a) accepted or b) objected to by the Examiner.

 Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

 Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).

11) The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

12) Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
a) All b) Some * c) None of:
1. Certified copies of the priority documents have been received.
2. Certified copies of the priority documents have been received in Application No. _____.
3. Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

1) Notice of References Cited (PTO-892)
2) Notice of Draftsperson's Patent Drawing Review (PTO-948)
3) Information Disclosure Statement(s) (PTO-1449 or PTO/SB/08)
Paper No(s)/Mail Date 1/29/04.
4) Interview Summary (PTO-413)
Paper No(s)/Mail Date. .
5) Notice of Informal Patent Application (PTO-152)
6) Other: .

DETAILED ACTION***Election/Restrictions***

1. Applicant's election of Group 2 in the reply filed on August 16, 2004 is acknowledged. Because applicant did not distinctly and specifically point out the supposed errors in the restriction requirement, the election has been treated as an election without traverse (MPEP § 818.03(a)).

- (a) Claims 25 – 37 and 41 – 53 are elected.
- (b) Claims 38 – 40 and 54 – 56 are non-elected claims (see page 9 of applicant's remarks filed on August 16, 2004).

Drawings

2. The drawings are objected to under 37 CFR 1.83(a). The drawings must show every feature of the invention specified in the claims. Therefore, the limitation in claim 41 "a PCB substrate or a stiffener mounted to the heat spreader" must be shown or the feature(s) canceled from the claim(s). No new matter should be entered.

Corrected drawing sheets in compliance with 37 CFR 1.121(d) are required in reply to the Office action to avoid abandonment of the application. Any amended replacement drawing sheet should include all of the figures appearing on the immediate prior version of the sheet, even if only one figure is being amended. The figure or figure number of an amended drawing should not be labeled as "amended." If a drawing figure is to be canceled, the appropriate figure must be removed from the replacement sheet, and where necessary, the remaining figures must be renumbered and appropriate changes

made to the brief description of the several views of the drawings for consistency.

Additional replacement sheets may be necessary to show the renumbering of the remaining figures. The replacement sheet(s) should be labeled "Replacement Sheet" in the page header (as per 37 CFR 1.84(c)) so as not to obstruct any portion of the drawing figures. If the changes are not accepted by the examiner, the applicant will be notified and informed of any required corrective action in the next Office action. The objection to the drawings will not be held in abeyance.

Specification

3. The disclosure is objected to because of the following informalities: the specification needs units for the coefficient of thermal expansion.

Appropriate correction is required.

Claim Objections

4. Claims 32 – 34 and 48 – 50 are objected to because of the following informalities: In claims 32 – 34 and 48 – 50, need units for the coefficient of thermal expansion. Appropriate correction is required.

Claim Rejections - 35 USC § 112

5. The following is a quotation of the second paragraph of 35 U.S.C. 112:

The specification shall conclude with one or more claims particularly pointing out and distinctly claiming the subject matter which the applicant regards as his invention.

6. Claims 29 and 45 are rejected under 35 U.S.C. 112, second paragraph, as being indefinite for failing to particularly point out and distinctly claim the subject matter which applicant regards as the invention.

The phrase "such as" renders the claim indefinite because it is unclear whether the limitations following the phrase are part of the claimed invention or not. See MPEP § 2173.05(d). Furthermore, the term "other material" does not clearly and distinctly point out the subject matter which applicant regards as the invention.

Claim Rejections - 35 USC § 102

7. The following is a quotation of the appropriate paragraphs of 35 U.S.C. 102 that form the basis for the rejections under this section made in this Office action:

A person shall be entitled to a patent unless –

(b) the invention was patented or described in a printed publication in this or a foreign country or in public use or on sale in this country, more than one year prior to the date of application for patent in the United States.

8. Claim 25 is rejected under 35 U.S.C. 102(b) as being anticipated by Juskey et al. (U. S. Pat. No. 5,371,404).

Regarding claim 25, Juskey et al. discloses in e.g., Fig. 4 a heat spreader ball grid array package, comprising:

- a ball grid substrate (10);
- a semiconductor chip (16) affixed to the ball grid substrate;
- a molding compound (20) encasing the semiconductor chip over the ball grid substrate;
- a heat spreader (29) mounted over the ball grid substrate and spaced apart from the molding compound to form a gap; and

- thermal grease (27) within the gap at least between the heat spreader and the molding compound.

Claim Rejections - 35 USC § 103

9. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all

obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

10. Claims 26, 27, 34 and 35 - 37 are rejected under 35 U.S.C. 103(a) as being

unpatentable over Juskey et al. in view of Long et al. (U. S. Pat. No. 5,175,612).

Regarding claims 26 and 27, Juskey et al. discloses in e.g., Fig. 4 the use of the semiconductor chip (column 3, line 47), the material of the molding compound being comprised of epoxy resin (column 4, lines 8 – 14) and the use of a heat spreader (29; column 4, line 63). However, Juskey et al. does not appear to provide any example of the semiconductor chip's specific composition to be a silicon (claim 26), the specific epoxy molding compound also including a curing agent and the heat spreader's specific composition to be an aluminum (claim 27). Long et al. teaches in e.g., Fig. 2 a semiconductor chip (52) material to be composed of a silicon (column 1, lines 42 – 42), an epoxy molding compound (28 and 60) also including a curing agent (column 4, lines 25 – 34) and a heat spreader (64) material to be an aluminum (column 6, lines 16 – 19). It would have been obvious to one of ordinary skill in the art at the time the present invention was made to apply the silicon as the specific material to form the semiconductor chip; the curing agent with the epoxy molding compound as the specific

material to form the molding compound and the aluminum as the specific material to form the heat spreader in the structure of Juskey et al. as taught by Long et al. to (1) provide a good heat dissipation (column 6, lines 16 – 19) and (2) to attach the heat sink directly to the chip (column 6, lines 28 – 30).

Regarding claim 34, Since Juskey et al. and Long et al. disclose silicon semiconductor chip that has 2 to 3 ppm/°C of the coefficient of thermal expansion (see column 3, lines 1 – 2 of Kresge et al.), Juskey et al. and Long et al. disclose the limitation “the semiconductor chip has a coefficient of thermal expansion of from “about” 2.5 to 3.5”.

Regarding claims 35 – 37, while Juskey et al. discloses in e.g., Fig. 4 the use of a heat spreader (29; column 4, line 63) and the thermal grease (27) nearly filling the gap (at the space between the molding compound and the heat sink; claim 37), Juskey et al. does not appear to provide another example of the heat spreader’s specific shape to be an inverted square pie tin that has an elongated surrounding lip (claims 35 - 37); and a specific material to attach the heat spreader onto the substrate to be an epoxy adhesive (claim 36). Long et al. teaches in e.g., Fig. 3 the shape of the heat spreader (82) to be an inverted square pie tin (88) that has an elongated surrounding lip (at the “L” shape of the element 88 on the element 44B; column 7, lines 60 - 62); and a specific material (44b) to attach a heat spreader (82 and 88) onto a substrate (48) to be an epoxy adhesive (column 3, lines 1 – 3). It would have been obvious to one of ordinary skill in the art at the time the present invention was made to apply the shape of the inverted square pie tin with an elongated surrounding lip as the specific shape of the heat spreader and the epoxy adhesive as the specific attaching material for the heat spreader to the substrate in the

structure of Juskey et al. as taught by Long et al. to provide a pedestals or a mounting area for the heat sink (column 7, lines 60 – 61).

11. Claims 28, 32 and 33 are rejected under 35 U.S.C. 103(a) as being unpatentable over Juskey et al. in view of Culnane et al. (U. S. Pat. No. 5,785,799), and further in view of Primeaux (U. S. Pat. No. 5,331,205).

Regarding claim 28, while Juskey et al. discloses in e.g., Fig. 4 the material of the molding compound being comprised of epoxy resin (column 4, lines 8 – 14) and the use of a heat spreader (29; column 4, line 63), Juskey et al. does not appear to provide any example of the heat spreader's specific composition to be a copper. Culnane et al. teaches in e.g., Fig. 1 a heat spreader (118) material to be a copper (column 2, lines 56 - 57). It would have been obvious to one of ordinary skill in the art at the time the present invention was made to apply the copper as the specific material to form the heat spreader in the structure of Juskey et al. as taught by Culnane et al. to attach the heat sink directly to the chip (column 2, lines 56 – 59).

Regarding claims 32 and 33, Since Juskey et al. and Culnane et al. disclose the use of a copper heat spreader that has 17 ppm/ $^{\circ}\text{C}$ (see column 2, lines 4 – 6 of Burgess) for the coefficient of thermal expansion, Juskey et al. and Culnane et al. disclose the limitation “the heat spreader has a coefficient of thermal expansion of about 17.0”. However, Juskey et al. and Culnane et al. do not appear to provide any example of the epoxy molding compound's specific range of the coefficient of thermal expansion. Primeaux teaches in e.g., column 4, lines 59 – 64 the epoxy molding compound's specific range of the coefficient of thermal expansion including 10 to 60 ppm/ $^{\circ}\text{C}$. Note that

“about” 7.0 includes 10 ppm/°C about the same based in the metes and bounds of “about” disclosed in the specification. It would have been obvious to one of ordinary skill in the art at the time the present invention was made to further apply the 10 to 60 ppm/°C as the specific range of the coefficient of thermal expansion for the epoxy molding compound in the structure of Juskey et al. as taught by Primeaux to further protect the wire bonds and keep them rigidly fixed in place during subsequent transfer molding (column 4, lines 65 - 68).

12. Claim 41 is rejected under 35 U.S.C. 103(a) as being unpatentable over Juskey et al. in view of Lee et al. (U. S. Pat. No. 6,362,530).

Juskey et al. discloses in e.g., Fig. 4 a heat spreader ball grid array package, comprising:

- a ball grid substrate (10);
- a semiconductor chip (16) affixed to the ball grid substrate;
- a molding compound (20) encasing the semiconductor chip over the ball grid substrate;
- thermal grease (27) over the molding compound; and
- a heat spreader (29) mounted over the ball grid substrate (10), the molding compound (20) and the thermal grease (27).

However, Juskey et al. does not disclose a PCB substrate mounted to the heat spreader. Lee et al. teaches in e.g., Fig. 2D a PCB substrate (240) mounted to a heat spreader (224). It would have been obvious to one of ordinary skill in the art at the time the present invention was made to apply the PCB substrate onto the heat spreader in the

structure of Juskey et al. as taught by Lee et al. to allow the heat spreader to be directly attached to a heat dissipating pad of the printed circuit board to dissipate heat away from die through the printed circuit board (column 7, lines 52 – 57).

13. Claims 42, 43, 50 and 51 - 53 are rejected under 35 U.S.C. 103(a) as being unpatentable over Juskey et al. and Lee et al. as applied to claim 41 above, and further in view of Long et al. (U. S. Pat. No. 5,175,612).

Regarding claims 42 and 43, Juskey et al. and Lee et al. disclose in e.g., Fig. 4 the use of the semiconductor chip (column 3, line 47), the material of the molding compound being comprised of epoxy resin (column 4, lines 8 – 14) and the use of a heat spreader (29; column 4, line 63). However, Juskey et al. and Lee et al. do not appear to provide any example of the semiconductor chip's specific composition to be a silicon (claim 26), the specific epoxy molding compound also including a curing agent and the heat spreader's specific composition to be an aluminum (claim 27). Long et al. teaches in e.g., Fig. 2 a semiconductor chip (52) material to be composed of a silicon (column 1, lines 42 – 42), an epoxy molding compound (28 and 60) also including a curing agent (column 4, lines 25 – 34) and a heat spreader (79) material to be an aluminum (column 6, lines 16 – 19). It would have been obvious to one of ordinary skill in the art at the time the present invention was made to further apply the silicon as the specific material to form the semiconductor chip; the curing agent with the epoxy molding compound as the specific material to form the molding compound and the aluminum as the specific material to form the heat spreader in the structure of Juskey et al. and Lee et al. as taught by Long et

al. to (1) provide a good heat dissipation (column 6, lines 16 – 19) and (2) to attach the heat sink directly to the chip (column 6, lines 28 – 30).

Regarding claim 50, Since Juskey et al. and Long et al. disclose silicon semiconductor chip that has 2 to 3 ppm/ $^{\circ}$ C of the coefficient of thermal expansion (see column 3, lines 1 – 2 of Kresge et al.), Juskey et al. and Long et al. disclose the limitation “the semiconductor chip has a coefficient of thermal expansion of from “about” 2.5 to 3.5”.

Regarding claims 51 – 53, while Juskey et al. and Lee et al. disclose in e.g., Fig. 4 the use of a heat spreader (29; column 4, line 63) and the thermal grease (27) nearly filling the gap (at the space between the molding compound and the heat sink; claim 53), Juskey et al. and Lee et al. do not appear to provide another example of the heat spreader’s specific shape to be an inverted square pie tin that has an elongated surrounding lip (claims 51 – 53); and a specific material to attach the heat spreader onto the substrate to be an epoxy adhesive (claim 52). Long et al. teaches in e.g., Fig. 3 the shape of the heat spreader (82) to be an inverted square pie tin (88) that has an elongated surrounding lip (at the “L” shape of the element 88 on the element 44B; column 7, lines 60 - 62); and a specific material (44b) to attach a heat spreader (82 and 88) onto a substrate (48) to be an epoxy adhesive (column 3, lines 1 – 3). It would have been obvious to one of ordinary skill in the art at the time the present invention was made to further apply the shape of the inverted square pie tin with an elongated surrounding lip as the specific shape of the heat spreader and the epoxy adhesive as the specific attaching material for the heat spreader to the substrate in the structure of Juskey et al. and Lee et

al. as taught by Long et al. to provide a pedestals or a mounting area for the heat sink (column 7, lines 60 – 61).

14. Claims 44, 48 and 49 are rejected under 35 U.S.C. 103(a) as being unpatentable over Juskey et al. and Lee et al. as applied to claim 41 above, and further in view of Culnane et al. (U. S. Pat. No. 5,785,799), and further in view of Primeaux (U. S. Pat. No. 5,331,205).

Regarding claim 44, while Juskey et al. and Lee et al. disclose in e.g., Fig. 4 the material of the molding compound being comprised of epoxy resin (column 4, lines 8 – 14) and the use of a heat spreader (29; column 4, line 63), Juskey et al. and Lee et al. do not appear to provide any example of the heat spreader's specific composition to be a copper. Culnane et al. teaches in e.g., Fig. 1 a heat spreader (118) material to be a copper (column 2, lines 56 - 57). It would have been obvious to one of ordinary skill in the art at the time the present invention was made to further apply the copper as the specific material to form the heat spreader in the structure of Juskey et al. and Lee et al. as taught by Culnane et al. to attach the heat sink directly to the chip (column 2, lines 56 – 59).

Regarding claims 48 and 49, Since Juskey et al. and Culnane et al. disclose the use of a copper heat spreader that has 17 ppm/ $^{\circ}\text{C}$ (see column 2, lines 4 – 6 of Burgess) for the coefficient of thermal expansion, Juskey et al. and Culnane et al. disclose the limitation “the heat spreader has a coefficient of thermal expansion of about 17.0”. However, Juskey et al. and Culnane et al. do not appear to provide any example of the epoxy molding compound's specific range of the coefficient of thermal expansion. Primeaux teaches in e.g., column 4, lines 59 – 64 the epoxy molding compound's specific

range of the coefficient of thermal expansion including 10 to 60 ppm/ $^{\circ}$ C. Note that “about” 7.0 includes 10 ppm/ $^{\circ}$ C about the same based in the metes and bounds of “about” disclosed in the specification. It would have been obvious to one of ordinary skill in the art at the time the present invention was made to further apply the 10 to 60 ppm/ $^{\circ}$ C as the specific range of the coefficient of thermal expansion for the epoxy molding compound in the structure of Juskey et al. as taught by Primeaux to further protect the wire bonds and keep them rigidly fixed in place during subsequent transfer molding (column 4, lines 65 - 68).

Allowable Subject Matter

15. Claims 29 – 31 and 45 – 47 are objected to as being dependent upon a rejected base claim, but would be allowable if rewritten in independent form including all of the limitations of the base claim and any intervening claims.

(a) Claims 29 and 45 contain allowable subject matter because none of references of record teach or suggest, either singularly or in combination, at least the limitation of a thermal grease comprising silicon rubber containing heat-conducting particles that is selected from the group consisting of a zinc oxide, an aluminum oxide, an aluminum nitride, a boron nitride or a ceramic fillers which have the properties of heat conduction;

(b) Claims 30 and 46 contain allowable subject matter because none of references of record teach or suggest, either singularly or in combination, at least the limitation of a thermal grease comprising an epoxy resin, a curing agent, a

catalyst, a coupling agent, a filler, a flame retardant, a mold-release agent, a

coloring agent and a stress-relief agent; and

(c) Claims 31 and 47 contain allowable subject matter because none of references of record teach or suggest, either singularly or in combination, at least the limitation of a thermal grease comprising an epoxy resin, a curing agent, a catalyst and a coupling agent.

Conclusion

16. The prior art made of record and not relied upon is considered pertinent to applicant's disclosure. Sarihan et al., Gaynes et al., Mizunashi, Johnson et al., Barrow and Rostoker et al. disclose a heat sink for semiconductor device.

Any inquiry concerning this communication or earlier communications from the examiner should be directed to Chris C. Chu whose telephone number is 571-272-1724.

The examiner can normally be reached on 10:30 - 8:00.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Tom Thomas can be reached on 517-272-1664. The fax phone number for the organization where this application or proceeding is assigned is 703-872-9306.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR.

Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see <http://pair-direct.uspto.gov>. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free).

Chris C. Chu
Examiner
Art Unit 2815

c.c.
9/7/04 12:45:48 AM


GEORGE ECKERT
PRIMARY EXAMINER